

What is claimed is:

1        1. In a data network with router having memory for storing entries for a plurality  
2 of destinations from the router, a method of performing route lookup that places a  
3 bound on the number of accesses to the memory, the method comprising the steps  
4 of:

5                determining the costs of all possible lookup architectures that can be  
6 constructed given the distribution of destinations in the data network;

7                choosing a lookup architecture which requires the minimum amount of  
8 memory to obtain the next hop of any destination and that places a bound on the  
9 number of memory accesses to obtain the next hop; and

10               after receipt of a data packet, using the chosen lookup architecture to lookup  
11 a route for a destination address associated with the data packet.

1        2. The method of claim 1 wherein the step of determining the costs of all  
2 possible architectures further comprises the step of determining all possible lookup  
3 trees.

1        3. The method of claim 2 wherein the step of choosing a lookup architecture  
2 further comprises the step of choosing a lookup tree that requires the minimum  
3 amount of memory to obtain the next hop of any destination and that places a  
4 bound on the number of memory accesses to obtain the next hop

1        4. The method according to claim 1 further comprising the step of arranging the  
2 destinations supported by the router in a tree-like architecture.

1 5. The method according to claim 4 further comprising the step of arranging the  
2 destinations supported by the router in a radix tree architecture.

3  
4 6. The method according to claim 1 further comprising the step of storing  
5 the destinations associated with data packets as addresses.

1 7. The method according to claim 6 further comprising the step of storing the  
2 destinations associated with data packets as IP addresses.

1 8. The method according to claim 1 further comprising the step of calculating  
2 the cost associated with performing the route lookup for a data packet.

1 9. The method according to claim 8 further comprising the step of determining  
2 if the cost associated with performing the route lookup is minimum.

1 10. The method according to claim 9 wherein the cost associated with  
2 performing the route lookup is based on the memory required to store the lookup  
3 architecture.

1 11. The method according to claim 9 wherein calculating the cost associated  
2 with performing the route lookup is calculated based on a length of a destination  
3 address for the data packet.

1 12. The method according to claim 9 wherein calculating the cost associated

1 with performing the route lookup is calculated by summing values based on a height  
2 in which the node is located and costs associated with performing the route lookup  
3 of individual routes below the node for which the cost is being calculated.

1 13. The method according to claim 1 wherein an optimum value associated with  
2 performing the route lookup is a cost associated with minimum memory usage in  
3 performing the route lookup.

1 14. The method according to claim 1 wherein the number of accesses to the  
2 memory are used to locate a destination address associated with the route.

1 15. The method according to claim 14 wherein the destination address is an  
2 Internet Protocol (IP) destination address.

1 16. A method for performing a route lookup in a router for a data packet with an  
2 associated destination address, the method comprising the steps of:  
3 inspecting the destination address associated with the data packet; and  
4 using the destination address to access a memory space containing a lookup  
5 architecture to arrive at the next hop for the data packet which is serviced by the  
6 router, wherein the lookup architecture is adapted for bounding the number  
7 accesses to the memory space for any destination address of the data packet.

1 17. The method of claim 16 wherein lookup architecture is further  
2 adapted to minimize the amount of memory required to meet any bound on  
3 accesses to the memory space for any particular destination address.

1 18. The method of claim 16 further comprising the steps of"  
2 determining the lookup architecture; and  
3 storing the lookup architecture in the memory space.  
4

5 19. The method of claim 18 wherein the step of determining the lookup  
6 architecture further comprises the steps of:

7 determining the costs of all possible lookup architectures that can be  
8 constructed given the distribution of destinations in the data network containing the  
9 router; and

10 choosing a lookup architecture which requires the minimum amount of  
11 memory to obtain the next hop of any destination and that places a bound on the  
12 number of memory accesses to obtain the next hop.

1 20. The method of claim 19 further comprising the step of using the chosen  
2 lookup architecture to lookup a route for a destination address associated with the  
3 data packet.

1 21. The method according to claim 18 wherein the step of storing the lookup  
2 architecture further comprises the step of storing the lookup architecture in a tree-  
3 like architecture.

1 22. The method according to claim 18 wherein the step of storing the lookup  
2 architecture further comprises the step of storing the lookup architecture in a radix  
3 tree architecture.

1 23. The method according to claim 16 further comprising the step of saving

1 the lookup architecture in a routing table containing route information for any  
2 destination address serviced by the router.

1 24. The method according to claim 16 further comprising the step of  
2 calculating the cost associated with performing the route lookup for the data packet.

1 25. The method according to claim 24 further comprising the step of  
2 determining with the cost associated with performing the route lookup exceeds a  
3 specified value and, if so, replacing the route entry with a destination having a  
4 maximum route lookup size.

1 26. The method according to claim 24 wherein cost associated with  
2 performing the route lookup is calculated based on a length of the destination  
3 address.

1 27. The method according to claim 24 wherein the cost associated with  
2 performing the route lookup is calculated by summing values based on a height in  
3 which the destination is located and costs associated with performing the route  
4 lookup of individual routes below the destination for which the cost is being  
5 calculated.

1 28. The method according to claim 24 wherein an optimum value associated  
2 with performing the route lookup is a cost associated with a minimum memory  
3 usage in performing the route lookup.

1 29. The method according to claim 16 wherein the destination address is an

1 Internet Protocol (IP) destination address.

1 30. In a data network including a plurality of destinations and a plurality of  
2 routes for reaching the destinations, a router adapted to minimize the costs of route  
3 lookup for data packets routed in the data network, the router comprising:

4 an interface to incoming links of the data network;

5 logic means for receiving incoming data packets from the data network  
6 through said interface and for determining the destination of data packets,  
7 determining the route to the next hop along a destination, and routing data packets  
8 on a route extending to a next hop; and

9 a memory space accessible by the logic means and adapted for storing a  
10 lookup architecture for routes;

11 wherein the lookup architecture that places a bound on the number  
12 accesses to the memory space for any destination address of the data packet.

1 31. The router of claim 30 wherein the lookup architecture is further  
2 adapted to minimize the amount of memory required to meet any bound on  
3 accesses to the memory space for any particular destination address.

1 32. The router of claim 30 wherein said lookup architecture is arranged as a  
2 compressed radix tree.

1 33. The router of claim 30 wherein the lookup architecture stores an optimum  
2 value associated with performing the route lookup in terms of the cost associated  
3 with a minimum memory required to meet a particular bound.